

## TITLE OF THE INVENTION

### DISK CARTRIDGE AND DISK RECORDING REPRODUCING APPARATUS

## CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of Korean Patent Application No. 01-8997 filed on February 22, 2001 in the Korean Industrial Property Office, the disclosure of which is incorporated herein by reference.

## BACKGROUND OF THE INVENTION

### 1. Field of the Invention

[0002] The present invention relates to a disk cartridge and a disk recording/reproducing apparatus, and more particularly, to a disk cartridge and a disk recording/reproducing apparatus which are designed to effectively remove foreign materials from the surface of a disk.

### 2. Description of the Related Art

[0003] As shown in FIG. 1, a typical disk cartridge 1 for housing a disk 2, such as an optical disk or a magnetic disk, has a shutter 3 slidably installed at one side of the disk cartridge, such that a disk recording/reproducing apparatus can record data to and reproduce data from the disk 2 by accessing the disk using its header (not shown) while selectively opening or closing the shutter 3.

[0004] However, since it is common that no protective layers are formed on the disk 2 housed in the disk cartridge 1, a foreign material such as fine dust attached on the surface of the disk 2 is very likely to cause serious errors during recording and reproduction of information to and from the disk. Also, in the case of a disk that is not housed in a cartridge and has a protective layer formed on the disk, a foreign material attached on the surface of the disk is very likely to cause errors during recording and reproduction of information to and from the disk. However, particularly, the disk 2, which is housed in the cartridge 1 without protective layers, has a greater possibility of errors being generated due to attachment of a foreign material to the surface of the disk 2.

[0005] In order to reduce the possibility of generating errors in the conventional art, a cleaning apparatus, as shown in FIGS. 1 through 3, is installed in the cartridge 1 to remove a foreign material from the surface of the disk 2. The cleaning apparatus includes a support arm 4 rotatably installed in the cartridge 1, a cleaning member 5 installed in the support arm 4 to contact the surface of the disk 2, and a lever 6 protruding outside the cartridge 1 so that a user may rotate the support arm 4. Thus, upon cleaning, as shown in FIGS. 1 and 3, the support arm 4 is rotated over the disk 2 so that the cleaning member 5 contacts the disk 2 while it rotates, thus removing a foreign material from the surface of the disk 2. Upon recording/reproducing, as shown in FIG. 2, the support arm 4 is then rotated in the opposite direction so that the cleaning member 5 does not disturb the disk 2.

[0006] However, in the above-described disk cartridge, a separate cleaning apparatus, as described above, must be installed in the cartridge 1 so that the number of component parts increases, and also the thickness of the cartridge 1 must be increased. Thus, the conventional disk cartridge is disadvantageous for the purpose of condensing a disk recording/reproducing apparatus. Also, in the case of disks having no protective layers formed thereon, the conventional disk cartridge can cause serious errors to the disk 2 when the cleaning member 5 directly contacts the surface of the disk 2.

[0007] Therefore, a disk cartridge capable of removing foreign materials from the surface of a disk in a non-contact manner, while protecting the surface of the disk, is required.

## SUMMARY OF THE INVENTION

[0008] Accordingly, it is an object of the present invention to provide an improved disk cartridge and an improved disk recording/reproducing apparatus to remove foreign materials from the surface of a disk using the flow of air during disk rotation.

[0009] Additional objects and advantages of the invention will be set forth in part in the description which follows and, in part, will be obvious from the description, or may be learned by practice of the invention.

[0010] The foregoing objects of the present invention are achieved by providing a disk cartridge including a case housing an information recording/reproducing disk and a shutter

which is installed within the case and selectively opened and closed to accomplish an access of the disk to a recording/reproducing apparatus, wherein a protrusion group having a plurality of protrusions, each protruding toward the disk, is formed on the inner wall of at least one of the case and the shutter.

**[0011]** The above objects of the present invention may also be achieved by providing a disk cartridge including a case housing an information recording/reproducing disk and a shutter which is installed within the case and selectively opened and closed to accomplish an access to the disk by a recording/reproducing apparatus, wherein a protrusion group, having a plurality of protrusions each protruding toward the disk, is rotatably formed within the case so that the protrusions are located over and under the disk or escaped from the region over and under the disk.

**[0012]** The above objects of the present invention may also be achieved by providing a disk cartridge including a case housing an information recording/reproducing disk and a shutter which is installed on the case and selectively opened and closed to accomplish access to the disk by a recording/reproducing apparatus, wherein a protrusion group having a plurality of protrusions, each protruding toward the disk, is formed within the case so as to ascend or descend, such that the protrusions approach the disk or are isolated from the disk.

**[0013]** The above objects of the present invention may also be achieved by providing a disk recording/reproducing apparatus recording information on or reproducing information from a disk while rotating the disk loaded within a housing, wherein a protrusion group, having a plurality of protrusions each protruding toward the disk, is rotatably formed within the housing so that the protrusions are located over and under the disk or escaped from the region over and under the disk.

**[0014]** The above objects of the present invention may also be achieved by providing a disk recording/reproducing apparatus recording information on or reproducing information from a disk while rotating the disk loaded within a housing, wherein a protrusion group having a plurality of protrusions, each protruding toward the disk, is formed within the house so as to ascend or descend, such that the protrusions approach to the disk or are isolated from the disk.

## BRIEF DESCRIPTION OF THE DRAWINGS

[0015] These and other objects and advantages of the present invention will become apparent and more readily appreciated from the following description of the embodiments, taken in conjunction with the accompanying drawings of which:

FIGS. 1 through 3 are plan views of a conventional disk cartridge including a separate disk cleaning apparatus;

FIG. 4 is a perspective view of a disk cartridge according to an embodiment of the present invention;

FIGS. 5A and 6 are cross-sections of the disk cartridge of FIG. 4 taken long line A-A, illustrating the effects that flowing of air during disk rotation under the structure of a protrusion group exerts on the surface of a disk;

FIG. 5B is a cross-section of the disk cartridge of FIG. 4 taken along line B-B;

FIGS. 7A through 8 show variations in pressure and flow velocity depending on the flow of air during rotation of a disk;

FIGS. 9 and 10 show modified shapes of the protrusion group shown in FIG. 4;

FIGS. 11 and 12 show modified arrangements of the protrusion group shown in FIG. 4;

FIG. 13A is a plan view of a disk cartridge according to another embodiment of the present invention;

FIG. 13B shows a modification of the disk cartridge of FIG. 13A;

FIG. 14A is a plan view of a disk cartridge according to yet another embodiment of the present invention;

FIG. 14B shows a modification of the disk cartridge of FIG. 14A;

FIG. 15 is a perspective view of a disk cartridge according to yet another embodiment of the present invention;

FIG. 16A is a plan view of a disk recording/reproducing apparatus according to the embodiment illustrated in FIG. 14A;

FIG. 16B shows a modification of the disk recording/reproducing apparatus of FIG. 16A; and

FIG. 17 is a perspective view of a disk recording/reproducing apparatus according to the embodiment illustrated in FIG. 15.

## DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0016] Reference will now be made in detail to the embodiments of the present invention, examples of which are illustrated in the accompanying drawings, wherein like reference numerals refer to the like elements throughout. The embodiments are described below in order to explain the present invention by referring to the figures.

[0017] Referring to FIG. 4, a disk cartridge 10 according to an embodiment of the present invention includes a case 12 housing a disk 13, a shutter 11 installed on the case 12 so that it is opened and closed to accomplish access to the disk 13 by a recording/reproducing apparatus, and foreign material filters 14. A protrusion group 20 having a plurality of protrusions 21 (first, second, third, .... , and n-th protrusions) protruding toward the disk 13 is formed on the inner wall of the case 12 or on the inner wall of the shutter 11. As shown in FIGS. 4 and 5B, the protrusions 21 linearly stretch in the radial direction of the disk 13, and the protrusion group 20 having the protrusions 21 is disposed at a plurality of places at an equiangular interval in the direction of rotation of the disk 13. The protrusion group 20 induces the flow of air caused during the rotation of the disk 13 to serve as a force to remove foreign materials from the surface of the disk 13. The protrusion group 20 is formed on each of the opposing upper and lower inner walls of the case 12 to apply a force to each of the upper and lower surfaces of the disk 13. The protrusion group 20 can be incorporated into the inner wall of the case 12 or shutter 11. Alternatively, the protrusion group 20 is separately manufactured and then coupled to the inner wall of the case 12 or shutter 11 by an attachment process.

[0018] FIGS. 5A and 6 are cross-sections of the disk cartridge of FIG. 4 taken a long line A-A, which theoretically illustrate the principle that flowing of air caused during the rotation of the disk 13 exerts a predetermined force on the surface of the disk by the protrusions 21.

[0019] Referring to FIG. 5A, air generated by the rotation of the disk 13 repeats compression and expansion while passing between the protrusions 21 of the protrusion group 20 and the disk 13. Thus, a pressure profile as indicated by a dotted line is formed on the disk 13, and the flow velocity of air becomes faster as air becomes closer to the surface of the disk 13, as indicated in a one-dot-one-dashed line.

[0020] Under this environment, if a foreign material 15 is attached to the surface of the disk 13, as shown in FIG. 6, a force due to the flow of air (which is indicated by a solid line) and a force due to a variation in pressure (which is indicated by a dotted line) are exerted on the foreign material 15. Theoretically, at the side where the pressure increases, a force due to the pressure is exerted in the opposite direction to the direction in which a force due to the flow of air is exerted. At the side where the pressure decreases, the two forces exert pressure in the same direction. Undoubtedly, the influence of the force generated by the flow of air is greater than that of the force generated by the variation in pressure, so that a drag force is exerted at any position in the direction of detaching foreign material 15 from the surface of the disk 13. However, summing of the two forces can accelerate the removal of the foreign materials.

[0021] However under actual test conditions, the result of simulation of a pressure distribution formed around the protrusions 21 as the disk 13 rotates is closer to what is shown in FIG. 7A than to what is shown in FIGS. 5A and 6. That is, theoretically, air passing under the protrusions 21 alternates compression and expansion, as shown in FIGS. 5A and 6. However, under the actual test conditions, air introduced under the protrusion group 20 is rapidly compressed at first and thus applies a great pressure to the disk 13. Then, while the compression of air decreases in stages without any distinct increase in pressure, the air eventually slips out of the place under the protrusion group 20 opposite to which it entered as the disk passes by the protrusion group 20. Accordingly, there are rarely pressure increasing regions between the disk 13 and the protrusion group 20, but regions where the pressure decreases in stages are usually formed between the disk 13 and the protrusion group 20. Thus, if there is a foreign material 15 at a position C in FIG. 7A, a greater pressure is applied to the left side (where the air enters between the protrusion group 20 and the disk 13) of the foreign material 15 than to the right side (where the air exits from between the protrusion group 20 and the disk 13) thereof, as shown in FIG. 7B, illustrating the decrease in pressure as the disk 13 rotates past the protrusion group 20. Therefore, the foreign material 15 is pushed to the right side and detached from the surface of the disk 13.

[0022] Undoubtedly, a force generated by the flow of air is also exerted in the above-described foreign material detaching process. The force generated by the flow of air occurring during the rotation of the disk 13 is proportional to the flow velocity of air, which varies between the protrusion group 20 and the disk 13. As a result of simulation, the distribution of the flow

velocity of air is formed as shown in FIG. 8. The result of simulation is almost consistent with the theoretical tendency shown in FIGS. 5A, 5B and 6. That is, FIG. 8 shows a pattern in which the velocity of air gradually increases while air is being compressed by the protrusions 21, reaches the summit around the apex of each of the protrusions 21, and then decreases a little.

In contrast, when the rotation velocity of the disk 13 is referred to as V1, and there are no protrusions 21, the flow velocity of air is a level (initial inflow velocity V2) which is similar to the rotation velocity of the disk 13. However, it can be seen that if there are protrusions 21 present as described above, the flow velocity of air greatly increases on the entire surface of the disk 13 as air is compressed by the protrusions 21.

**[0023]** Hence, when the disk cartridge 10 has a protrusion group 20 formed on the inner wall of the case 12 or shutter 11, foreign materials can be sufficiently removed from the surface of the disk 13 using the flow of air and the difference in pressure generated during the rotation of the disk.

**[0024]** The protrusion group 20 can be made up of variously-shaped protrusions 21, as shown in FIGS. 9 and 10. FIG. 9 shows that n protrusions 21 can have a variety of periodically-repeated shapes obtained by varying a plurality of variables. That is, a protrusion group 20 of FIG. 9 can be obtained by adjusting variables such as the distance (D) between the inner wall of the case 12 and the disk 13, the protrusion angles  $\theta_2$  and  $\theta_3$  of a protrusion 21, the distance (d) between the apex of a protrusion 21 and the disk 13, and the round values  $r_1$  and  $r_2$  of each protrusion. Alternatively, as shown in FIG. 10, a protrusion group having a shape of a sine curve can be formed. This sine curve shape can be expressed as a sine function:  $y=Dy \times \sin\{(2\pi/T) \cdot x - Dx\} + S$ .

**[0025]** The protrusion group 20 can be linearly disposed in the radial direction of the disk 13, as shown in FIGS. 4 and 11. Alternatively, as shown in FIG. 12, the protrusion group 20 can be divided into several parts, the parts being arranged in a stepped manner. The arrangement of divided protrusion groups 20', 20" and 20"', as shown in FIG. 12 in a stepped manner, is to allow foreign materials detached from the surface of the disk 13 to more smoothly slip out of the protrusion subgroups 20', 20" and 20''. That is, when the protrusion group 20 is disposed in a straight line, as shown in FIG. 11, foreign materials detached from the surface of the disk 13 must slip out of many protrusions 21. However, when the protrusion group 20 is

partitioned into several parts arranged in a stepped manner, the foreign materials detached from the surface of the disk 13 only have to slip out of relatively fewer protrusions 21 than the above case, so that the foreign materials can easily slip out of the protrusions 21.

[0026] According to the present invention, when protrusions 21 are formed toward the disk 13 on the inner wall of the case 12 or shutter 11 of the disk cartridge 10, foreign materials can be effectively removed from the surface of the disk without a complicated cleaning apparatus.

[0027] FIG. 13A is a plan view of a disk cartridge according to another embodiment of the present invention. The principle of removing foreign materials in this embodiment is the same as the above-described embodiment. However, in this present embodiment, a protrusion group 20a is not incorporated into or attached to the inner wall of the case 12 but installed as a separate member, which rotates around a rotation axis 20a', so that its position is selected according to its mode of operation. That is, the protrusion group 20a is formed so as to rotate around the rotation axis 20a' installed in the case 12, and a lever 20a" is installed so as to protrude outside the case 12. Thus, in a cleaning mode, the lever 20a" is turned so that the protrusion group 20a is located over and under the disk 13. In a normal mode, the lever 20a" is turned in reverse compared to the cleaning mode so that the protrusion group 20a can move out of the region over and under the disk 13. Accordingly, in a cleaning mode, the protrusion group 20a is located over and under the disk so that the same cleaning effect as that in the previous embodiment occurs. In a normal mode, the protrusion group 20a is isolated from the region over and under the disk, so that no cleaning effects occur. This embodiment is structured so that a user can selectively obtain a cleaning effect made by the protrusion group 20a as desired. Meanwhile, the protrusion group can adopt a structure in which several protrusion parts are arranged in the radial direction of the disk 13 in a stepped manner, as shown in FIG. 13B. The protrusion group 20a or 20b of FIGS. 13A or 13B, respectively, can be disposed at a plurality of positions at an equiangular interval in the direction of rotation of the disk 13.

[0028] FIG. 14A is a plan view of a disk cartridge according to yet another embodiment of the present invention. This embodiment is almost the same as the embodiment of FIG. 13A, except that the protrusion group 20a is not rotated by the manual manipulation of a user but by an automatic driving apparatus, such as, for example, a solenoid 30. Thus, the protrusion

group 20a can be rotated to desired positions by the driving of the solenoid 30. Reference numeral 31 denotes a power and signal connection terminal connected to the solenoid 30 or any other appropriate device. The power and signal connection terminal 31 is connected to a corresponding terminal (not shown) formed in a recording/reproducing apparatus when a disk cartridge is inserted into the recording/reproducing apparatus, so that it is provided with a power supply and a signal. The protrusion group can adopt a shape in which protrusion groups 20b are arranged in a stepped manner in the radial direction of the disk 13, as shown in FIG. 14B. Protrusion group 20a or 20b shown in FIGS. 14A or 14B, respectively, can be disposed at a plurality of places at an equiangular interval in the direction of rotation of the disk 13.

**[0029]** FIG. 15 is a perspective view of a disk cartridge according to yet another embodiment of the present invention. While the disk cartridges according to the embodiments of FIGS. 13A and 14A rotate their corresponding protrusion groups, the disk cartridge according to this embodiment elevates a protrusion group 20c over and under the disk 13. That is, the protrusion group 20c is installed so that it ascends and descends along a guide rail 40, and approaches or departs the disk 13 by a driving apparatus, such as a solenoid 30. Thus, in a cleaning mode, the protrusion group 20c generates a cleaning effect by moving toward the disk 13. In a normal mode, the protrusion group 20c is isolated from the disk 13 to prevent variations in flow velocity and pressure from being caused by the protrusions. The protrusion group 20c can adopt a structure in which several protrusion groups are arranged in the radial direction of the disk 13 in a stepped manner, as shown in FIG. 14B. The protrusion group 20c can be disposed at a plurality of positions at an equiangular interval in the direction of rotation of the disk 13.

**[0030]** According to the aforementioned embodiments, a disk cartridge according to the present invention can be modified into various shapes.

**[0031]** The removal of foreign materials using the protrusion group of the present invention is not limited to only disk cartridge applications. That is, in the cases of disks that are not housed in cartridges, the protrusion group is installed in the housing of a recording/reproducing apparatus, including a turntable on which a disk is seated. Accordingly, since the housing of a recording/reproducing apparatus is the same as the disk cartridge in that it surrounds a disk, if the housing also has various shapes of protrusion groups protruding toward the disk, as

described above, forces generated by the flow of air and a pressure variation are exerted on the surface of the disk in the same manner as when a disk rotates within a cartridge.

**[0032]** FIG. 16A is a plan view of a disk recording/reproducing apparatus adopting a protrusion group according to the embodiment illustrated in Fig. 11 of the present invention . This embodiment is similar to the above-described embodiment of Fig. 13A employing a disk cartridge. In the disk recording/reproducing apparatus according to the embodiment of FIG. 16A, a protrusion group 20d is rotatably installed within a housing 50 and rotated by a driving apparatus, such as, for example, a solenoid 30. In a cleaning mode, the protrusion group 20a is rotated and located over and under the disk 13, such that a cleaning effect is generated by the flow of air caused during the rotation of the disk 13. In a normal mode, the protrusion group 20d moves away from the region over and under the disk 13 so that it does not affect the surface of the disk 13. The protrusion group according to this embodiment can adopt a structure in which several protrusion groups 20e are arranged in the radial direction of the disk 13 in a stepped manner as shown in FIG. 16B. The protrusion group 20d or 20e of FIGS. 16A or 16B, respectively, can be disposed at a plurality of positions at an equiangular interval in the direction of rotation of the disk 13.

**[0033]** FIG. 17 is a perspective view of a disk recording/reproducing apparatus adopting a protrusion group according to the embodiment of FIG. 15 employing a disk cartridge. In the disk recording/reproducing apparatus according to this embodiment, a protrusion group 20f is installed within a housing 50 so that it ascends and descends along a guide rail 51, and approaches or moves away from the disk 13 by a driving apparatus, such as, for example, a solenoid 30. Thus, in a cleaning mode, the protrusion group 20f generates a cleaning effect by approaching the disk 13. In a normal mode, the protrusion group 20f is isolated from the disk 13 to prevent variations in flow velocity and pressure from being caused by the protrusions. The protrusion group 20f can adopt a structure in which several protrusion groups are arranged in the radial direction of the disk 13 in a stepped manner, as shown in FIG. 16B. Furthermore, the protrusion group 20f can be disposed at a plurality of positions at an equiangular interval in the direction of rotation of the disk 13.

**[0034]** As described above, various types of protrusion groups in the disk cartridges according to the above-described embodiments can be equally used within the housing 50, so that foreign materials can be removed from the surface of the disk 13 using the flow of air.

**[0035]** According to the above embodiments, when a protrusion group protruding toward a disk is formed on the inner wall of a case, which surrounds the disk, such as a disk cartridge or a housing, forces due to the flow of air and a variation in pressure caused during the rotation of a disk are exerted on the surface of the disk, thereby removing foreign materials, such as dust, from the surface of the disk.

**[0036]** As described above, in a disk cartridge and a disk recording/reproducing apparatus according to the present invention, a protrusion group is formed within the cartridge or the housing of the disk recording/reproducing apparatus so as to face the disk, such that forces generated by the flow of air and a pressure variation are exerted on the surface of the disk during the rotation of the disk. Therefore, foreign materials can be effectively removed from the surface of the disk without a separate cleaning apparatus.

**[0037]** Although a few preferred embodiments of the present invention have been shown and described, it would be appreciated by those skilled in the art that changes may be made in this embodiment without departing from the principles and spirit of the invention, the scope of which is defined in the claims and their equivalents.